

# Ice Sheet System model What ISSM cannot do (yet)

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#### Larour et al.

- Outline
- Ice models
- Basal conditions
- Inversion and data assimilation
- 4 Ice/atmosphere interactions
- 6 Ice/ocean interactions
- 6 Other capabilities
- Numerics





# Missing capabilities Larour et al.

#### Ice models

#### Basal conditions

## Inversion and data assimilation

### interactions

#### ice/ocean interactions

#### Other capabilities

#### Numerics

### Ice models

- Ice anisotropy not included (ice fabrics)
- → Ice considered isotropic
- Cold ice model used in thermal model
- → No polythermal ice
  - · Moving grounding line based on hydrostatic equilibrium
- → Not implemented for full-Stokes (based on contact mechanics)
  - · Ice front and margins fixed in time, no calving law
- → Calving rate equal to ice velocity





#### Larour et al.

Ice models

#### Basal conditions

Inversion and data assimilation

interactions

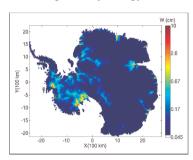
Ice/ocean interactions

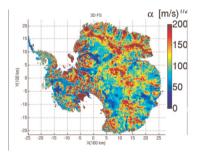
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lumerics

### Basal conditions

- · Basal friction fixed in time
- · Hydrology not coupled to basal friction
- · Sub-glacial hydrology only
- → No englacial hydrology









### Larour et al.

Ice models

Rasal conditions

### Inversion and data assimilation

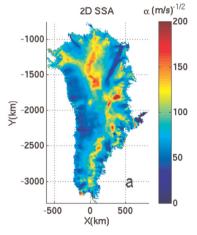
Ice/atmosphere

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Other canabilities

Numerics

### Inversions and data assimilation



Inversions limited to:

- · Ice rheology
- · Basal friction
- Ice thickness consistency with velocities
- $\rightarrow$  Assimilation for a given time





#### Larour et al.

Ice models

Basal conditi

Inversion and data assimilation

## Ice/atmosphere interactions

lce/ocean interaction

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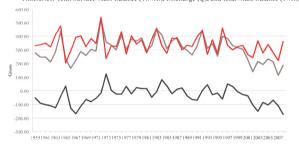
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### Ice/atmosphere interactions

Interaction between ice and atmosphere not modeled

- Surface mass balance transformed into ice
- → No PDD model (Positive Degree Day)
  - · Snow instantaneously transformed into ice
- → No firn compaction

Timeseries: Total Surface Mass Balance (TSMB), Discharge (O), and total Mass Balance (TMB)



Schlegel et al., in preparation





#### Larour et al.

#### Ice models

### Basal conditions

## Inversion and data

Ice/atmosphere interactions

#### Ice/ocean interactions

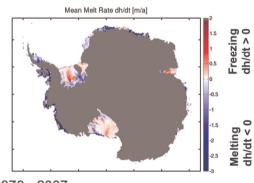
Other capabilities

lumerics

### Ice/ocean interactions

Interaction between ice and ocean not included

- Melting rates under ice shelved prescribed
- Sea level fixed at z=0
- $\rightarrow$  ECCO3 project to couple ocean and ice models





Schodlok et al., submitted





#### Larour et al.

#### Ice models

#### Rasal conditions

### Inversion and data

Ice/atmosphere

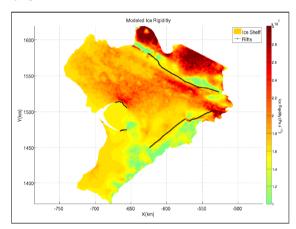
lce/ocean interaction

#### Other capabilities

**Numerics** 

## Other capabilities

- · Post-glacial rebound
- · Rift propagations







# Missing capabilities Larour et al.

#### Ice models

#### Basal conditions

### Inversion and da

### interactions

#### ice/ocean interactions

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#### Numerics

### **Numerics**

- · Only triangle (2D) and prismatic (3D) elements
- → No quadrangle elements
  - Only P1 (piecewise linear nodal functions)
- → No quadratic or higher-order interpolations
  - Non-linear iterations based on Picard method (fixed-point)
- → No Newton iterations
  - Direct solver used for full-Stokes model
- → No scalable solver (iteratif solver)





